

REMARKS

Claims 17-51 are now pending in the application. Pursuant to 37 C.F.R §1.142, Claims 26-32 have been withdrawn. Further, Claims 17, 19-22, 33, 36, 38, 40-46, 48, and 50 have been amended to more particularly point out and claim the present invention. Support for these amendments is found in Applicants' specification at Paragraphs 18, 19, 21, 22, 23, 25, and 35, for example. Claim 36 has been amended to address a mere informality, and is commensurate in scope to the claim as originally filed. Entry of these amendments is requested. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

REJECTIONS UNDER 35 U.S.C. §§ 102 AND 103

Claims 17, 19-22, 33-36, 38, 40-45 and 47-50 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Chen, et al (2003/0129126), hereinafter the "Chen" reference. Claims 17-25, 33-38, 40-43 and 45-51 stand rejected under 35 U.S.C. § 102(e) as anticipated by Chen, or in alternative, under 35 U.S.C. § 103(a) as obvious over Chen. These rejections are respectfully traversed.

The present invention relates to a reversible hydrogen storage system where an imide compound is formed by the reaction of two hydrogen-containing starting compounds. A common feature of the amended independent Claims 17, 20, 21, 22, 33, 48, and 50 is that an imide reversibly stores hydrogen and is represented by $M^c(NH)^{-2}_{c/2}$,

where M represents a cationic species of at least one of: Li, Mg, Na, B, Al, Be, Zn, and c represents an average valence state of M.

The Chen reference does not disclose forming a reversible imide hydrogen storage material where the cationic species is at least one of Li, Mg, Na, B, Al, Be, Zn. While the Chen reference discloses using a commercially available calcium imide (Paragraph 68 at page 5, for example), calcium does not generally follow the simple chemistry of relatively lighter cationic elements, instead forming related phases, generally categorized as hydride/nitrides. See Applicants' specification at Paragraph 22 pages 7 – 8, for example. A common feature of the independent claims of the present application is forming a reversible hydrogen storage material that is an imide where the cationic species are limited to one or more of Li, Be, Mg, Na, Al, Be, Zn. This excludes calcium. Since these particular elements form compounds that are characterized as true imides and amides, they are highly useful for methods of reversibly storing hydrogen with a high hydrogen content by contacting an imide with hydrogen.

While the Chen reference discloses various reactions to store hydrogen, the Chen reference does not disclose reacting two hydrogen-containing storage materials (*e.g.*, an amide $M^c(NH)^{-2}_{c/2}$ and a hydride MII^fH_f , as recited in independent Claims 17, 22, 48, and 50) together to form the imide hydrogen storage material that reversibly stores hydrogen.

Chen does not disclose forming an imide hydrogen storage material from a reaction of an amide and a hydride, nor does it disclose forming an imide hydrogen storage material having a cationic species of at least one of: Li, Mg, Na, B, Al, Be, Zn, and mixtures thereof. In Chen, where the cationic species is lithium, a nitride (such as

Li_3N) is reacted with pure hydrogen to form an amide (such as LiNH_2) and a hydride (such as LiH). The amide and hydride are further reacted with more hydrogen to form an allegedly novel compound. Paragraphs 45-46 at page 4; Equation 3. While the Chen reference refers to this compound as a lithium-enriched imide, the compound has a different structure and allegedly different and improved physical characteristics. Paragraphs 45 and 49 at page 4. As reflected in Equation 3, an imide could potentially be formed, however, the Chen reference explicitly discloses that the only reversible reaction to store hydrogen occurs with the novel compound Li_mNH_n , where $2 < m < 3$, $0 < n < 1$, $m+n = 3$, being exposed to hydrogen at specific temperature and pressure conditions to form an amide and a hydride. Equation 4 and Paragraphs 49-51 on Page 4. Thus, the reaction between Li_mNH_n and hydrogen was demonstrated to be the only route for reversible hydrogen storage. See, *e.g.*, Paragraph 49 at Page 4. The Chen reference does not disclose or suggest that an imide can be reacted with hydrogen to regenerate to a hydrogenated state forming the amide and hydride compounds, and specifically excludes a lithium imide compound from Equation 4.

In fact, the Chen reference teaches away from forming a reversible hydrogen storage imide material at all, because while it discloses that an imide can be formed in Equation 3, it then goes on to exclude an imide compound from being formed from the hydrogen release reaction of an amide and a hydride in Equation 4, where m is greater than 2 and n is less than 1 (but not greater than or equal to and less than or equal to, as in Equation 3). This reinforces the teaching that the allegedly novel "Li-enriched imide" is the only compound of the Chen reference that is disclosed or suggested as being capable of storing hydrogen and reversibly forming an amide and a hydride. Since

Chen fails to provide any disclosure or motivation to form an imide hydrogen storage material that reversibly stores hydrogen; has one or more cationic species: Li, Mg, Na, B, Al, Be, Zn; and is formed by a reaction between two hydrogen-containing compounds, namely an amide and a hydride, Chen does not anticipate or render independent Claims 17, 22, 48, and 50 obvious. Thus, Claim 17 and its dependent Claims 18, 19, and 20; Claim 22 and its dependent Claims 24 and 25; Claim 48 and its dependent Claim 49; and Claim 50 and its dependent Claim 51 are not anticipated nor are they rendered obvious by the Chen reference. Accordingly, Applicants respectfully request withdrawal of the rejection and reconsideration of these claims.

The Chen reference does not disclose reacting a nitride with an amide to form an imide. Further, there is no disclosure in Chen or suggestion to make an imide by reacting a nitride represented by the formula $MIII^9N_{3/9}$ with an amide represented by $MI^d(NH_2)_d^{-1}$, where M represents a cationic species of at least one of: Li, Mg, Na, B, Al, Be, Zn, as is recited in Claim 20. Rather, the Chen reference discloses reacting a nitride (such as Li_3N) with hydrogen to form an amide (such as $LiNH_2$) and a hydride (such as LiH). Since Chen discloses forming a specific and purportedly new lithium enriched imide compound as the only reversible hydrogen storage compound with lithium cations, there is no disclosure, suggestion, or motivation to react a nitride with an amide to form a reversible imide hydrogen storage material, and Claim 20 is not anticipated or rendered obvious by the Chen reference. Reconsideration of the claim and withdrawal of this rejection are respectfully requested.

Further, the Chen reference does not disclose heating an amide to form a reversible imide hydrogen storage material and ammonia, where the ammonia is

separated from the reaction product. The Chen reference describes reacting hydrogen with lithium nitride to store hydrogen and to form lithium amide and lithium hydride, however, a disadvantage was recognized of the potential for the lithium amide to decompose to lithium imide and ammonia (Paragraph 40 on page 3). Chen provides no disclosure or suggestion that an imide composition can reversibly store hydrogen. Further, Chen teaches away from using this particular reaction to form a hydrogen storage material, because of the implied avoidance of forming an imide composition, and a preference to form a lithium-enriched imide composition that is reversible according to Equation 4. There is no disclosure or suggestion in Chen to form an imide for reversible hydrogen storage by a decomposition reaction where the ammonia is separated, as is recited in Claim 21. Thus, Claim 21 is not anticipated nor is it rendered obvious by the Chen reference. Accordingly, Applicants respectfully request withdrawal of the rejection and reconsideration of this claim.

Finally, the Chen reference does not disclose a method of cycling hydrogen by mixing and then heating two particulate hydrogen-containing compounds to form an imide hydrogen storage material having a cationic species of one or more of: Li, Mg, Na, B, Al, Be, Zn, as recited in Claim 33. First, Chen fails to disclose storing hydrogen by reacting the imide with hydrogen. Secondly, there is no disclosure in Chen of heating particulates and releasing hydrogen, and then storing hydrogen in the imide storage material. The only disclosure in Chen of particle size relates to particles of lithium nitride that absorb pure hydrogen. Paragraph 41 at Page 3. There is no further disclosure, suggestion or motivation to provide hydrogen-containing compounds in particulate form to reversibly cycle hydrogen. Thus, Claim 33 is not anticipated, nor is it

rendered obvious over Chen. The same holds true for its dependent Claims 34-47. Applicants respectfully request withdrawal of the rejections and reconsideration of these claims.

REJECTION UNDER DOUBLE PATENTING

Applicants note the Examiner's provisional rejection under the judicially created doctrine of obviousness-type double patenting of Claims 17-25 and 33-51 over co-pending parent application U.S. Application Serial No. 10/603,474 claims 1-14.

Applicants respectfully delay substantively responding until such time as one of the co-pending applications should issue.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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